ELEMENTS

**RENEWABLE ENERGY OPTIONS 6.6.3**

One of the most important features that the DNR Green Building could incorporate to reduce environmental impact is that of renewable energy to offset a portion of grid supplied electricity that comes primarily from coal production in this region. The US Green Building Council's LEED program recognizes this fact by awarding 1 to 3 points for projects that use renewable energy to provide 5, 10, or 20 percent of their power respectively. More innovation credits may be available for projects that exceed this total.

The US Green Building council recognizes wind power and photovoltaics as renewable energy sources and it is these technologies that are encouraged for use in the DNR Green Building. A quick summary of the potential of these technologies for the project and next steps are contained below. John Andrews of Rumsey Engineers wrote the wind power summary. Jason F. McLennan of Elements wrote the solar power summary.

**Wind Power**

In initial analysis of wind energy feasibility for the Missouri Department of Natural Resources site in Jefferson City, MO, a potential for up to 5 percent to 15 pecent of total annual building energy was found achievable by reasonable wind turbine installations. Although an in-depth study needs to be performed on both wind directions and speed at the exact site, the preliminary estimates show potential annual energy savings of over $3000 per year. This quick, rule-of-thumb estimate takes an average wind speed of 20 miles per hour and uses three, standard, large turbines. Efficiencies were estimated based on equipment data and $0.06 per kilowatt-hour was used as a virtual energy rate.

There are, however, many factors involved in completing a more accurate analysis of the site potential. For instance, the power generated from a wind turbine varies to the cube power of the wind speed. Therefore, the difference of an 8 miles per hour wind compared to a 15 miles per hour wind could mean an energy decrease difference of nearly 85 percent [1-(8/15)^3]. Also, all turbines have a minimum wind speed, which they need for low power operation. Often this limitation of low wind speed cuts off a substantial amount of the hours that the turbine is available during the year. This minimum can be as low as one mph for smaller turbines and up to 7 or more miles per hour for larger, less sensitive models. This factor alone could rule out some types and scales of installation.

Current weather conditions with a one-week lag from Jefferson City Memorial Airport can be accessed through http://nndc.noaa.gov/?http://ols.ncdc.noaa.gov/cgi-bin/nndc/gensub.cgi
(Username: super password: symmetry).

Although this data is useful for temperatures, humidity and general wind speed and direction, the data does not represent the actual weather conditions at the exact site. Being on a bluff or placing a turbine 30 or more feet off the ground dramatically affects the recorded wind speed. These two factors of height and hill placement usually increase wind speed, but without site-specific data, there is no way to be sure.

In order to determine the actual feasibility of installing wind power at the site, monitoring of exact wind speeds and direction should be considered. This monitoring can range in cost from $10,000 to $15,000. Additional analysis of this data is estimated to cost approximately $13,000 depending on the scale of analysis and type of data collected.

**Solar**

Photovoltaics (PV) convert sunlight directly into energy with no moving parts and are an extremely reliable source of electricity. Like wind power, energy generation by photovoltaics is highly dependent on current environmental conditions and the availability of sunlight.

The percentage of building power that could be generated by photovoltaics depends on the efficiency of the cells deployed, their orientation, tilt and the size of the array. With the site available it is possible to generate more than enough power for all the building needs by using photovoltaics on the roof or on other site structures such as covered parking. Other than the water tower, no site obstructions interfere with the availability of sunlight on the site. It is very feasible that 5 to 20 percent of the building power requirements can be met from photovoltaics, with cost being the only limiting factor.

Below is a rough approximation of the size and cost of such arrays based on a building load of 340 kilowatts:
5% array = 17 kW, $140 000 cost, 1700 sf array
10% array = 34 kW, $280, 000 cost, 3400 sf array
20% array = 68 kW, $560 000 cost, 6800 sf array

More research on the exact type and location of the system most appropriate for the project can be done during design development if funding permitting.